

RHIC Retreat: Orbit and BPM Issues

Room 305

*** Achievements**

- 128 turns of orbit through each entire ring
- Routine orbit correction through arcs, closure
- Offline difference orbits, optics analysis
- 128-turn injection tune, injection efficiency

*** System functional but not well-integrated**

*** Primary Issues**

- Improve robustness, reliability, monitoring and ease of use
- Improve configuration checks, bottom to top
- Improve integration: tunemeter, coupling...
- High priorities: DX/IR bpms and IR correction

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Room 305

*** Instrumentation: IFEs, DSPs, infrastructure (Degen)**

- Most required functionality in place, e.g. modes
(Except switch between 30 Hz injection bunches)
- Working towards reliability and maintenance
e.g. module setup, reset procedures, 1394 net
- Configuration management needed w/controls
- Reset/system status tools needed for operations
e.g. overflow/underflow/reset status bits
- High priorities: repair/replace/check DX/IR BPMs,
consistent uptime and operational availability

*** Controls: ADOs and FECs (Olsen)**

- ADO/parameter design good for commissioning
- FEC stability serious issue, improved early August
- Adding several sanity checks, recovery methods
- Issue: AdolIf reconnect to rebooted FEC ADOs
- Possible issue: How to sequence mode changes?
- High priority: sanity checks, FEC stability/recovery

*** Manager: data gathering and correlation**

- Data correlation worked, within orbit system
- Reversed plane management awkward: database?
- Needs graceful way to reconnect to reset FECs
- High priority: efficiency, reliability, stability

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Room 305

*** Injection: display, closure, tuning (Fischer)**

- Orbit closure often very quick and efficient
- Lambertson/injection threading: 'expert' activity
- Want new dual-plane BPMs near x/y pitch mags
- Scripts used for closure instead of RhicInjection
- Data correlation issues between ATR and RHIC?
- High priority: establish injection threading scheme

*** RHIC: display, correction, analysis (Ptitsyn)**

- Three-bumps and arc corrections very effective
- Global correction, esp over IRs, not demonstrated
- Possibly add intelligence to correction
(e.g. corrector weighting near broken BPMs)
- How to measure/correct at various step-stones,
especially while ramping?
- High priorities:
 - Establish global correction methods
 - Establish IR luminosity tuning procedures

*** Integration**

- High priorities:
 - Thorough configuration checkout
 - Pre-beam integration tests, to orbit correction

CAD AP: Operations Analysis

- * Physics Applications Coordination**

- * Online and Offline Physics Modeling**

- Online: Difference orbits, modeled optics
- Offline: Lattice design, tracking

- * Orbit System: Commissioning to Operational**

- Orbits, correction, tune, chrom, coupling, lumi...
- System integration, configuration checkout
- Algorithm/config tests with/without beam

- * Experiment/Machine Physics Coordination**

- Machine parameters, e.g. luminosity

Primary BPM System Issues to be Addressed by December '99 Startup

- Replace / repair non functioning BPM modules.
- Repair, test and install remaining BPM modules.
- BPM module software modifications to increase reliability.
 - Add watchdog timer to AIR mode
 - Enhance debug mode reliability
 - Add automatic mode switching to debug mode
- Modify gate array to:
 - Increase Beam Synch Clock decoder immunity to signal interruptions.
 - Perform beam timing measurements.
- Fix AC power distribution in the equipment buildings.
- Address beam synch fanout unit reliability. Repair and modify existing units.
- Clean BPM module air filters, establish schedule.
- Add input buffer resistor to BPM module Beam Synch Clock decoder.
- Install BPM attenuator heat sinks.

BPM ADO Stabilization

The first versions of the ADO did some rudimentary hardware checking at initialization

- ADO probes plane's base address
bad instances are put into simulation mode
- ADO probes specified TBT buffer address
bad instances are put into SERVICE mode

Failures after successful initialization common.

AdoIf, clock FEC tasks hang.

Repeated, frequent 'sanity checking' became necessary.

Later versions of the ADO check reasonableness of

Starting offset

buffer length

number of entries

Planes with suspect values are put into SERVICE mode.

Debug level alarms are generated.

FEC tasks continue to service other instances.

BPM ADO Stabilization

Future Enhancements

- Use Hardware Heartbeat

10 get limit

- Automatic return from SERVICE mode

RHIC Injection Algorithms, Codes and Tools

Wolfram Fischer

Dejan, Don, Johannes, Jörg, Mai, Nick,
Pat, Steves, Teds, Waldo, ...



RHIC Retreat, Stony Brook, 16 September 1999

Issues

- Injection path
- Injection kicker strength
- Operational procedures HERA-p/RHIC
- Algorithm/Codes/Tools
- Future plans

Fig. 3

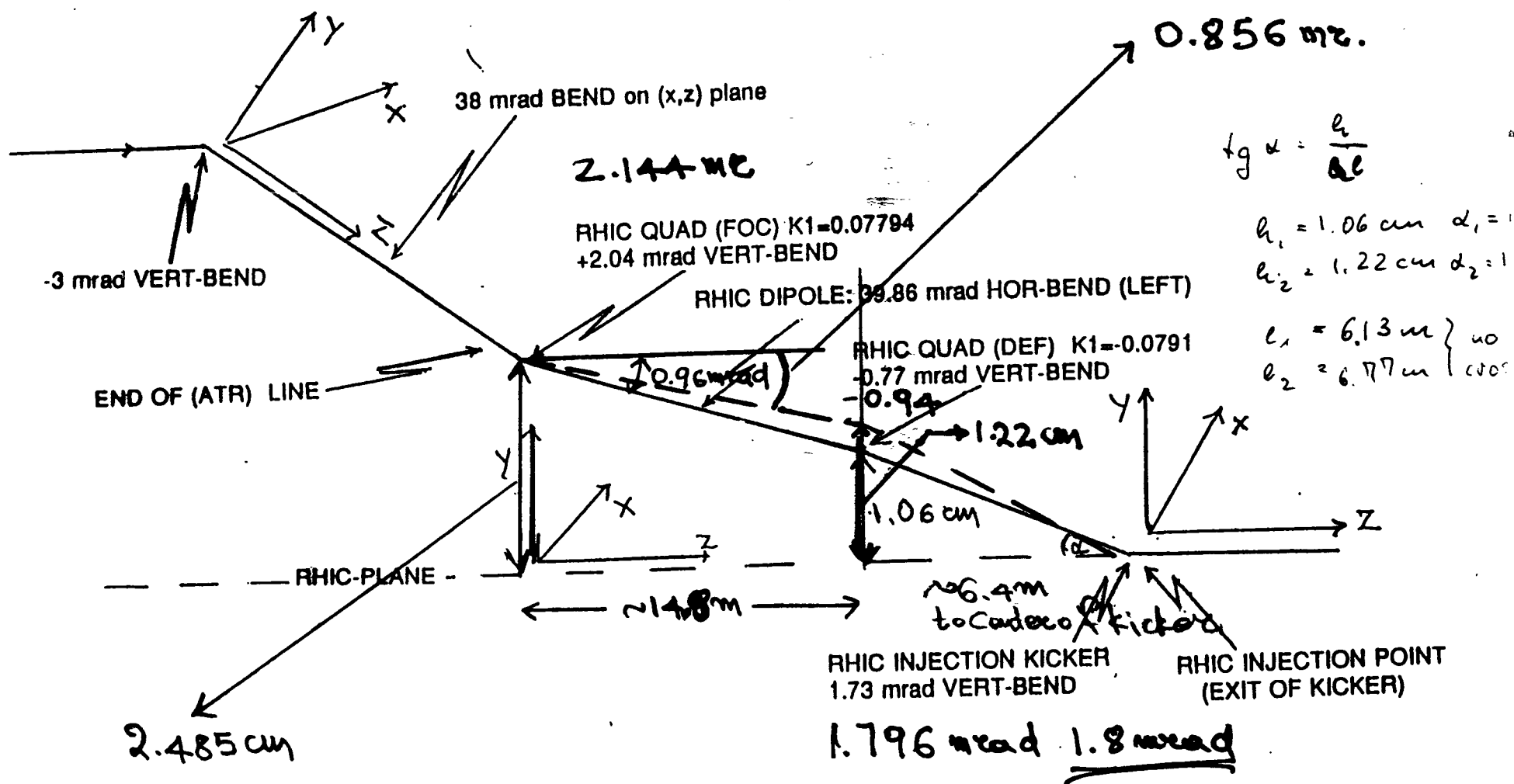


Figure. 3

HERA-p versus RHIC comm.

- Measure Δp , change B
- Measure closed orbit deviation (CO stored), use 2 corr. per plane in transfer line to correct
- Adjust Q and ξ , fill
- Good cases: ~ 15 min
- Bad cases: ~ 1 h
- Transfer line orbit is adapted to ring orbit
- Inject beam into ring
- Smooth first turn orbit deviation from design
- Close first turn, use 2 corr. Per plane in ring
- Iterate process to minimize losses in injection region
- Ring orbit is adapted to transfer line orbit

Algorithm

- Same standard algorithm for
 - * injection into closed orbit
 - * first turn closure
- Use 2 correctors per plane (~ 90 degrees apart) to minimize orbit deviation in 2 BPMs (~ 90 degrees apart)

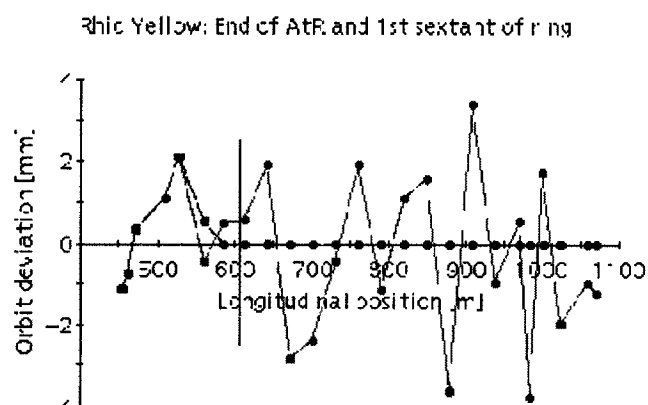
Codes

- RhicInjection
 - * uses 2 correctors per plane in AtR
 - * adapts AtR to ring
 - * no routinely usable since some correctors were always at limit (kicker too weak)
- closev/closeh (Jörg, ...)
 - * uses 2 correctors in ring to close orbit
 - * adapts ring to AtR
 - * routinely used

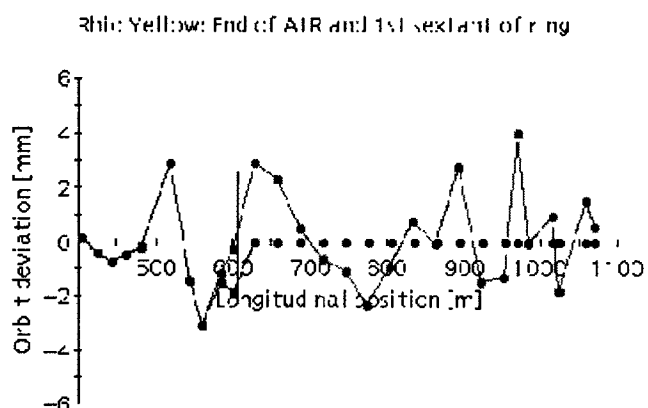
File Mode

Help

Horizontal plane



Vertical plane

Phase Space
Monitors AtRPhase Space
Monitors RHICInjection
CorrectorsClear
PlotsReinitialize
Program

RHIC

☒ Yellow☐ Blue

Display

☐ Phase Space☒ Orbit

Plot legend

New orbit

Target orbit

Hor plane

corr	design	old +-	new +-	status
element	mmrad	mmrad	mmrad	
yth9	0.000	0.122	0.057	on
ylamb	30.100	-0.021	-0.016	on

Ver plane

corr	design	old +-	new +-	status
element	mmrad	mmrad	mmrad	
yp1	2.930	0.031	-0.049	on
yki	1.870	0.008	-0.235	on

inject	factor	voltage	delay	status
kicker	V/mmrad	V	ns	
yki	16850	31678	128	on

Energy match

	gamma		gamma
AtR	12.100	Ring	12.100

Apply

Optimize

Orbit displayed.
Target orbit displayed.

Tools

- Codes (RhicInjection, closev/closeh)
- Orbit display
- Pet pages with BPM readings
(pet/RHIC/Injection/BlueOrbitClosure)
- Loss monitors
- Wall current monitor (future)

Inj. kicker strength



- Needed : 1.80mrad (rhic99, N. Tsoupas)
- Measured (with beam and BPMs):
 - Blue : (1.53 ± 0.07) mrad [34kV set point]
 - Yellow : (1.57 ± 0.09) mrad [38kV set point]
- Kickers appear to be 15% too weak
- Possible amelioration:
 - * change optics to rhic92 \Rightarrow $\sim 5\%$ less kick
 - * lower injection energy by $\sim 5\%$
 - * raise kicker voltage by $\sim 5\%$

Future

- Increase kicker strength by 10-15%
- Survey end of AtR
 - * beam position on x_f2/y_f2 not understood
 - * vertical correctors at end of AtR are always negative
- Install dual plane BPM at x_{p1}/y_{p1}
- Merge RhicInjection and closeh/closev

RHIC Retreat: Orbit/BPM Summary

*** System-wide Issues**

- Unstable
=> *FEC/ADO/IFE and system integration*
- Did not recover automatically from failures
=> *Controls/ADO work required*
- Configuration problems
=> *No time for full-scale configuration checkout*
=> *No central configuration responsibility*
- Missing channels
=> *Late hardware delivery, no spares*
- Most procedural knowledge was ad-hoc

RHIC Retreat: Orbit/BPM Summary

*** Instrumentation Issues**

- Stability problems
 - => *Global sensitivity to beam sync glitches*
 - => *No integration of hardware reset recovery*
 - => *Status monitoring and reset tools needed*
- Physical installation problems
 - => *DX and IR physical install problems*
 - => *DX BPMs don't work in both rings together*
 - => *Power distribution, fuses, heat loads*
- Digitizer overflow not flagged

*** Controls Issues**

- Stability
 - => *No FEC/ADO/AdolF automatic recovery*
- Controls configuration errors
- No large-scale integration period

*** Manager Issues**

- Inability to collect data from entire ring
- Reversed-plane management inefficient

RHIC Retreat: Orbit/BPM Summary

*** Orbit Control Issues**

- Global correction (esp IPs) not demonstrated
=> *Q4-Q4 bump closure*
- Effective automatic corrections not always used
=> *Lack of training, documentation, procedure*
=> *Lack of additional intelligence in correction*
- Awkward orbit measurement/correction up ramp
=> *No timing integration with ramp systems*
- IR steering for luminosity not demonstrated

*** Injection Issues**

- ATR injection correctors often at limits
=> *ATR orbit not well-corrected or maintained*
=> *Beam positions at x_f^2/y_f^2 not understood*
- RHIC injection kicker at limit